

REMARKS

Claims 1 and 55-81 are pending in this application.

Claims 1, 55, 61, 63-69, 77, 79 and 80-81 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. 6,671,055 to Wavering et al. (herein after Wavering or the Wavering reference). Claims 56-60, 62, 70-76 and 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wavering and in view of Lu, US 5,345,519 (herein after Lu or the Lu reference).

Claim 1, which is the only independent claim, is amended. Claims 55-57, 61, 67, 68, 70, 72, 77-79 and 81 are amended to conform to the amendments to claim 1 or to improve readability. Claims 62 and 80 are canceled, and the subject matter of claim 80 has been incorporated into claim 1. New claims 82-83 are added to further define the invention. Supports for claims 82-83 can be found in the specification on page 10, lines 8-12. No new matter has been added. Reconsideration of the present invention in view of the above amendments and remarks below is respectfully requested.

The Examiner relies primarily on the Wavering reference, which is also discussed in the specification of the present invention. As shown below, the Wavering does not anticipate or render amended claim 1 obvious. Importantly, Wavering critiques the type of sensors taught in Lu and thereby teaches away from combining with Lu.

Claim 1 is amended to further recite that

the launch waveguide is connected to a housing and when the housing is exposed to a pressure at a predetermined downhole location in an oil or gas well, and the exposure to the downhole pressure changes the dimensions of at least a portion of the housing to change the distance between the first and second reflecting surfaces, such that the pressure and temperature can be measured.

As amended, claim 1 is limited to a sensor that is capable of operating in an oil or gas well. As discussed in the background section of the specification of the present invention, Applicants discuss co-located optical sensors such as the ones disclosed in the applied Wavering reference (US 6,671,055), but that these interferometric optical sensors have not been employed in severe or harsh environment, such as those encountered in oil and gas wells. In contrast, Applicants discuss one example of an optical sensor usable in

oil and gas well (US 6,563,970) that resorts to complex pressure transducers and Bragg gratings (not interferometric signals as claimed) to measure pressure downhole. The Wavering reference itself also critiques another Bragg optical sensor for using “a complicated sensor housing design” to measure pressure downhole. (col. 2, lines 1-23).

Hence, to adapt optical sensors and more particularly interferometric sensors for downhole use in an oil or gas well is neither easy nor obvious. As amended, claim 1 recites that the structure that can accomplish this function is a housing connected to the launch waveguide or fiber, and when exposed to downhole pressure the housing changes its dimensions. This change in dimensions alters the distance between the first and second reflecting surfaces, which can be measured by the interferometric signal to yield the pressure measurement.

Supports for the amendment in claim 1 concerning the application of the sensor in oil or gas wells can be found in canceled claim 80. Supports for the amendment in claim 1 concerning the housing and its reaction to downhole pressure can be found in the present specification: Figure 1 shows housing 12 being exposed to downhole pressure (see also, specification from page 8, line 30 to page 9, line 3); Figures 10 and 14(a-c) show end cap 52 being connected to the launch fiber where distal cap surface 50 the end cap being exposed to downhole pressure (page 13, lines 11-26); Figures 11 and 12 show housing 12 being exposed to downhole pressure; Figure 15 shows the launch fiber being connected to a housing (82, 84, 86) where a portion of this housing (94) is exposed to downhole pressure.

On the other hand, the Wavering reference is silent as to how a pressure is communicated to or sensed by the pressure sensor. No housing whether or not connected to the launch waveguide is disclosed. Hence, amended claim 1 is novel over the Wavering reference.

Amended claim 1 is also non-obvious over Wavering alone or in combination with Lu. The Wavering reference does not teach a person of ordinary skill in the art the knowledge necessary to adapt its disclosed sensor to complex oil and gas applications. The Lu reference, as applied by the Examiner, cannot remedy the deficiencies of Wavering, because the optical sensor disclosed in Lu cannot measure both temperature and pressure. It is a temperature-compensated pressure sensor (see Lu’s Abstract)(“The

temperature compensation methods involved...”), and not a sensor that can measure both pressure and temperature, as claimed in amended claim 1. (*See also*, dependent claim 72 where temperature compensation is claimed).

Importantly, the Wavering reference pointedly critiques and distinguishes temperature-compensated pressure sensor from sensors that can measure both temperature and pressure. (See Wavering, from col. 1, line 31 to col. 2, line 37)(“These prior approaches have many limitations. Any approach that uses a mechanical means for thermally compensating pressure is limited in size, operating temperature, accuracy, commercialization, as well as *it does not actually provide a temperature measurement.*”)(emphasis added.) Hence, Wavering specifically teaches away from optical temperature-compensated pressure sensor, and a hypothetical combination of Wavering and Lu is not proper.

For these reasons, claim 1 as amended is patentable over Wavering and the combination of Wavering and Lu (or any other temperature-compensated optical pressure sensor).

The remaining claims are dependent directly or indirectly on claim 1 and are presently allowable based on their dependency. Applicants reserve the right to further support their patentability. Notwithstanding this reservation, Applicants traverse the Examiner’s conclusion that the subject matters of claims 65-67, independent of the limitations of claim 1, are not disclosed in Wavering. Wavering does not disclose one interferometric pair of reflected lights to measure temperature that are different from another interferometric pair that measures pressure, or that the temperature sensor is spaced apart from the cavity that measures the pressure.

Applicants also traverse the statement that Lu teaches a unitary construction formed by fusing a tube to the launch waveguide and capillary tube, as claimed in claim 70-76. Wavering also does not disclosed a sealed cavity as claimed in claim 81.

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully requests\ that the Examiner reconsider all presently outstanding rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason,

that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

A fee for a two-month extension of time is attached herewith. Since two dependent claims were cancelled and two were added, no other fee is believed due. If any other extension of time is required, it is hereby petitioned for under 37 C.F.R. § 1.136, and if any other required fee is due, the Commissioner may charge appropriate fees to H.T. Than Law Group, Deposit Account No. 50-1980.

Respectfully submitted,

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/H.T. Than/

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